



## High frequency of spontaneous triploids in barley

**Sandfær, Jens**

*Published in:*  
Hereditas

*Link to article, DOI:*  
[10.1111/j.1601-5223.1970.tb02280.x](https://doi.org/10.1111/j.1601-5223.1970.tb02280.x)

*Publication date:*  
1970

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Sandfær, J. (1970). High frequency of spontaneous triploids in barley. *Hereditas*, 64(1), 131-134.  
<https://doi.org/10.1111/j.1601-5223.1970.tb02280.x>

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

- KOLLER, P. C. 1938. The genetical and mechanical properties of the sex-chromosomes. IV. The golden hamster.—*J. Genet.* 36: 177—195.
- LEHMAN, J. M., MACPHERSON, I. and MOORHEAD, P. S. 1963. Karyotype of the Syrian hamster.—*J. Nat. Cancer Inst.* 31: 639—650.
- MILES, C. P. and KOONS, A. S. 1960. Sexual dimorphism in rat cells *in vitro*.—*Science* 131: 740.
- MOORE, K. L. 1962. Symposium on sex chromatin. The sex chromatin: Its discovery and variation in the animal kingdom.—*Acta Cytol.* 6: 1—12.
- 1965. Chromatin patterns in various rodents with special reference to sexual dimorphism in interphase nuclei.—*Acta Anat. (Basel)* 61: 488.
- 1966. Sex chromatin patterns in various animals.—*In The sex chromatin* (Ed. K. L. MOORE), London, p. 16—58.
- NAYYAR, R. P. and BARR, M. L. 1966. Sex chromatin in rodents.—*Can. J. Genet. Cat.* 8: 654—660.
- SCHMID, W. 1967. Heterochromatin in mammals.—*Arch. Jul. Klaus-Stift. Vererbforsch.* 42: 1—60.
- WALSH, M. P. 1955. A comparative study of sex differences in the somatic nuclei of the golden hamster.—*Anat. Rec.* 122: 487.
- WOLF, U., FLINSPACH, G., BOEHM, R. and OHNO, S. 1965. DNS-Reduplikationsmuster bei den Riesen-Geschlechtschromosomen von *Microtus agrestis*.—*Chromosoma* 16: 609—617.

Yngve Melander  
Institute of Genetics  
S-223 62 Lund, Sweden

### JENS SANDFAER: High frequency of spontaneous triploids in barley

(Received October 17, 1969)

Mostly from crosses between autotetraploids and diploids, various authors (KERBER 1954; TSUCHIYA 1958; DERENNE 1967; surveys by SMITH 1951 and NILAN 1964) have obtained triploid plants ( $2n = 3x = 21$ ) of cultivated barley (*Hordeum vulgare* L.). The number of triploids derived from such crosses has been low.

DERENNE (1967) and TSUCHIYA (1960) have described the development and meiotic cytology of barley triploids which produce many aneuploids, the most frequent of which were primary trisomics ( $2n = 2x + 1 = 15$ ). Triploids are thus valuable sources of trisomics, which are becoming increasingly useful in gene localization in barley. This paper describes a selection procedure that has led to a high yield of triploids in two barley varieties.

#### Materials and methods

In Svalöf Freja and Tystofte Prentice, both two-rowed spring varieties, seed samples of four subjectively defined size classes were selected by hand picking (Table 1) from unthreshed heads of material originating from one of our competition studies (SANDFAER 1968). The aim was a sample consisting of 200 seeds, but class 2 was so rare in Freja that only 37 seeds were obtained.

Root tips for chromosome counting were pre-treated for 4 hours at room temperature in a saturated  $\alpha$ -monobromonaphthalene solution,

fixed in 99 parts of 30 per cent ethanol to 1 part of lactic acid at 0° C (JACOBSEN 1954), hydrolyzed for 8 min in 1 N HCl at 60° C, cooled, and washed in water. Softening was done by cellulase (30 mg/ml, Aspergillus niger, Light) for 30 min at room temperature, followed by rinsing in distilled water. The root tips were stained in basic fuchsin for 15 min and squashed in aceto-orcein. Permanent mounts were made by quick-freezing of the squash preparation by means of a CO<sub>2</sub> squash-slide freezer (JACOBSEN 1965) followed by mounting in Canada balsam.

#### Results and conclusions

The germination in size class 1, Table 1, was very low for both varieties, but in class 2 92.4 per cent of the seeds of T. Prentice and 48.6 per cent of those of Freja germinated. Barley seeds with a 1000-kernel weight of 10—12 g are very thin and shrivelled, and they can easily be classified as unviable. In a normal seed-cleaning procedure they will be discarded.

While the plants in classes 3 and 4 were vigorous and uniform, those in classes 1 and 2 varied in size and morphology. Some of the plants were of a small, slender type (Fig. 1). These plants were usually a few days later in germination and were in the initial growth stages characterized by narrow leaves, which gave them a slender appearance. Since they did not represent a clear-cut

Table 1. The germination percentage in different seed-size classes and the distribution of the plants in morphological sub-classes

Size class no.	1000-kernel weight, g	Number of seeds	Germination %	Number of plants	Sub-class <sup>1</sup>	Number of plants
<i>T. Prentice</i>						
1	3.2	200	1.5	3	{ a	0
					{ b	0
					{ c	3
2	12.3	198	92.4	183	{ a	46
					{ b	100
					{ c	37
3	27.4	200	97.5	195	{ a	194
					{ b	1
					{ c	0
4	52.1	200	100.0	200	{ a	200
					{ b	0
					{ c	0
<i>Freja</i>						
1	3.5	173	0.6	1	{ a	0
					{ b	1
					{ c	0
2	10.5	37	48.6	18	{ a	6
					{ b	4
					{ c	8
3	28.2	200	100.0	200	{ a	198
					{ b	2
					{ c	0
4	54.5	200	100.0	200	{ a	199
					{ b	1
					{ c	0

<sup>1</sup> See text

type, the plants were grouped into three sub-classes: *a* normal, *b* intermediate, and *c* small, slender plants.

The chromosome numbers were determined in a small number of the plants in classes 3 and 4; all plants in these classes were found to be diploid. All plants in classes 1 and 2 were analyzed cytologically; the results appear in Table 2. A very high frequency of triploids, namely 89 per cent in *T. Prentice* and 75 per cent in *Freja*, was found in the 2-c class of small, slender plants. In the intermediary class, 2-b, a lower, but still considerable percentage of triploids was found, whereas no triploids were found in class 2-a, consisting of plants classified as morphologically normal. The results clearly demonstrate that a great number of plants raised from seeds with a 1000-kernel weight of about 10 g are triploids in both varieties. In *T. Prentice* 51 per cent of all plants grown from seeds of size class 2 were

triploids, and in *Freja* the percentage was 39. The results also show that within that class it is possible, by selection, according to plant height and morphology to separate a sub-class with an even higher frequency of triploids. The plants were grown to maturity, and all triploid and aneuploid plants were found to have a very high percentage of sterile flowers.

The frequency of seeds of the four size classes was determined for both varieties in material from the same plots as used in the experiment described. Size class 2, in which most of the triploids were found, constituted about 5 per cent of the *T. Prentice* seeds, whereas this size class was much rarer in *Freja*, viz. about 0.2 per cent. The frequency of triploids in the *T. Prentice* seed lot is estimated to be  $0.05 \times 0.92$  (germination in class 2)  $\times 0.51$  (triploids among germinated seeds) which equals 2.3 per cent, and the corresponding frequency was 0.04 per cent in *Freja*. It is obvious

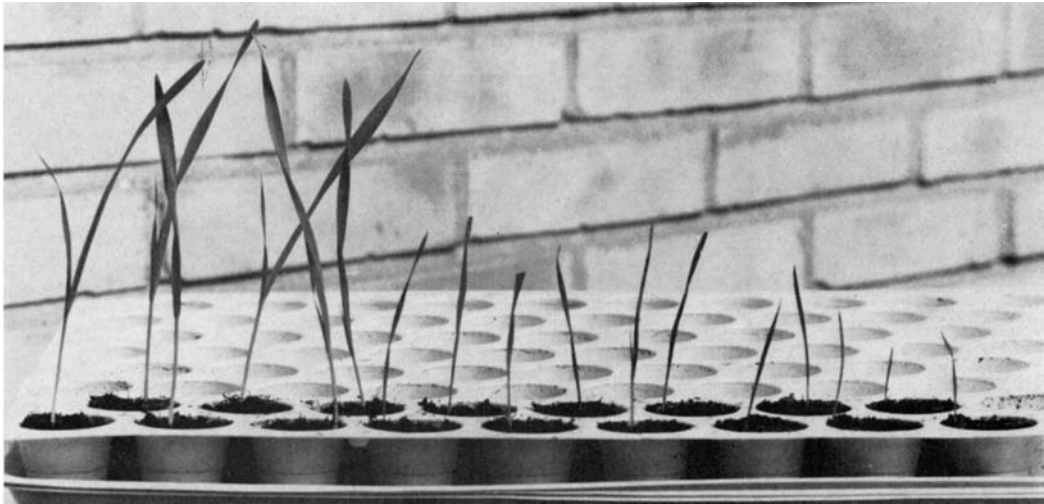


Fig. 1. From left to right: Normal, intermediate, and small slender plants.

that the frequency of triploids differed in the two seed lots.

To test the selection procedure suggested by the observations described, material of T. Prentice originating from the same plot as the material used in the experiment reported was threshed, as far as possible without discarding any of the light seeds by blowing. The seeds were then grouped in different seed-size classes on a seed cleaner in which an air stream fractionated the seeds according to specific gravity. Only two fractions were sown: Fraction I, containing 192 seeds with a 1000-kernel weight of 9.8 g, gave 156 plants; fraction II, containing 900 seeds with a 1000-kernel weight of 14.5 g, gave 840 plants. A strict morphological selection was carried out, yielding 40 and 70 plants of the small, slender type in fractions I and II, respectively. This sub-class constituted 26 per cent of the plants in fraction I and only 8 per cent in fraction II, which shows a clear decrease in the frequency of small, slender plants as a consequence of even a rather moderate increase in the 1000-kernel weight from 9.8 to 14.5 g. Out of the 110 small plants 105 were grown to maturity. Only two plants, presumably diploids, had normal fertility. The remaining 103 plants showed extensive flower sterility, and according to the cytological results already reported the majority of these plants were presumably triploids. Hence, in the material tested the method

described permits the separation of a large number of triploids without any great effort.

The T. Prentice line used carries the barley stripe mosaic virus, BSMV (SANDFAER 1970). Freja is normally free from BSMV, but the material used in this experiment had for some years been grown on plots next to T. Prentice, and a low infection rate was found in Freja. Since BSMV increases the frequency of sterile flowers (INOUE 1962; MCKINNEY and GREELEY 1965), it is possible that the triploids originated solely or primarily from virus-induced, so-called sterile flowers. This question cannot yet be finally settled. However, six triploids have been found in another sample of Freja and a virus-free line of T. Prentice has yielded four triploids. In these cases it was possible to trace the triploids back to their mother-plants. The triploids as well as about 50 other seeds from each mother plant were virus tested, and no virus infection was revealed. Four triploids were isolated from another spring barley variety, Abed Bomi, and no virus infection was found in triploids or in other plants from the same seed lot. These results indicate that triploid plants occur in virus-free as well in virus-infected material of some barley varieties. Other data indicate that the frequency of triploids is much higher in virusinfected than in virus-free material of T. Prentice.

**Table 2.** The frequency of diploids, triploids and aneuploids in different classes according to seed size and plant morphology

Class no. <sup>1</sup>	Total number of plants	Number of plants			Triploids in %
		Diploids 2n = 2x = 14	Triploids 3n = 3x = 21	Aneuploids <sup>2</sup>	
<i>T. Prentice</i>					
1—c	2	0	2	0	100.0
2—a	46	45	0	1 (2n = 2x + 1 = 15)	0.0
2—b	100	37	61	2 (2n = 2x + 1 = 15; 2n = 3x + 2 = 23)	63.0
2—c	37	2	33	2 (2n = 2x + 1 = 15; 2n = 3x + 1 = 22)	89.2
<i>Freja</i>					
1—b	1	1	0	0	0.0
2—a	6	6	0	0	0.0
2—b	4	3	1	0	25.0
2—c	8	1	6	1 (2n = 2x + 1 = 15)	75.0

<sup>1</sup> See Table 1<sup>2</sup> Observed chromosome number; most likely interpretation given in brackets

**Acknowledgements.**—I thank Mrs. Elly Ibsen for excellent technical assistance and Professor Ove Frydenberg for reading the manuscript and for valuable comments and suggestions. Thanks are also due to my colleagues Ib Linde-Laursen, Hans Doll, C. John Jensen, and Vagner Haahr.

### Summary

In the two barley varieties Tystofte Prentice and Svalöf Freja, the frequency of spontaneous triploids was found to be 2.6 and 0.04 per cent respectively. The triploids originated from light, shrivelled seeds. By selection, according to seed size, a group of plants was obtained in which the frequency of triploids was 51 per cent in *T. Prentice* and 39 per cent in *Freja*. Within this group the frequency of triploids could be further increased by selection according to plant morphology. In a sub-group of small, slender plants the frequency of triploids was 89 per cent in *T. Prentice* and 75 per cent in *Freja*. The material used of the two varieties was found to be infected with the barley stripe mosaic virus, but available data indicate that triploids also occur in the progeny of virus-free plants of these varieties, though the frequency of triploids was much higher in the virus-infected than in the virus-free material.

Agricultural Research Department, Danish Atomic Energy Commission, Research Establishment Risø, DK-4000 Roskilde, Denmark

### Literature cited

- DERENNE, P. 1967. Triploïdie et trisomie chez l'orge cultivée, I. L'état triploïde.—*Bull. Rech. Agron. Gembloux N. S.* 2: 242—259.
- JACOBSEN, P. 1954. Chromosome numbers in the genus *Hedera* L.—*Hereditas* 40: 252—254.
- 1965. An improved squash-slide freezer.—*Stain Technol.* 40: 63—65.
- KERBER, E. R. 1954. Trisomics in barley.—*Science* 120: 808—809.
- NILAN, R. A. 1964. The cytology and genetics of barley 1951—1962.—*Monogr. Suppl. No. 3, Res. Studies* 32, No. 1. Wash. State Univ.
- SANDFAER, J. 1968. Induced sterility as a factor in the competition between barley varieties.—*Nature* 218: 241—243.
- 1970. Barley stripe mosaic virus as the cause of sterility interaction between barley varieties.—*Hereditas* 64: 150—152.
- SMITH, L. 1951. Cytology and genetics of barley.—*Bot. Rev.* 17: 1—355.
- TSUCHIYA, T. 1958. Studies on cross compatibility of diploid, triploid and tetraploid barleys I. Seed development in reciprocal crosses between diploids and induced autotetraploids.—*Bot. Mag. Tokyo* 71: 48—52.
- 1960. Studies on cross compatibility of diploid, triploid and tetraploid barley, III. Results of 3x × 3x crosses.—*Seiken Zihō* 11: 29—37.